


Conference on Real Estate and Financial Stability
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Age, Demographics, and the Demand for Housing, Revisited

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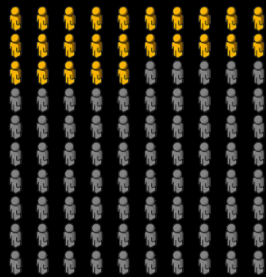
 USC Lusk Center for Real Estate

A FEW THINGS I WORRY ABOUT THANKS TO A YEAR IN GOVERNMENT

- Government technology
- Bank technology
- Reliance on non-bank lenders
 - Ginnie Mae issuers in particular
- Insufficient defaults
 - Brain dead lending
 - How do we model going forward?

Introduction: Baby Boomers and Housing Market

Baby Boomers: people who were born during the temporary peak in the birth-rate between the years 1946 and 1964 (U.S. Census Bureau, 2010)
 36 to 54 years old in 2000; ages 46 to 64 in 2010; 51 to 69 in 2015



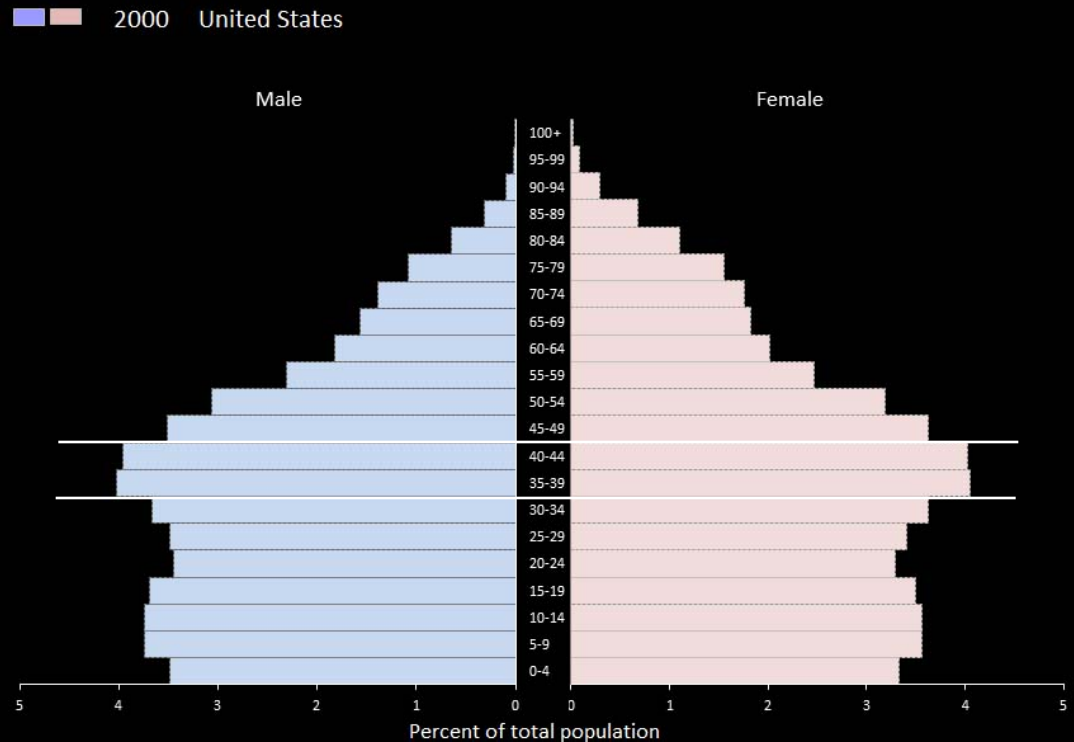
population
 77 mil.
 24.9%



household
 46 mil.
 39.6%



labor force
 60 mil.
 38.2%

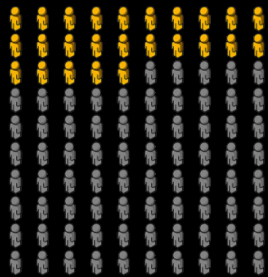


Source: U.S. Census Bureau, Census 2000 and 2010 Census.

Source: Census 2010 SF-1 H17, PCT12

Introduction: Baby Boomers and Housing Market

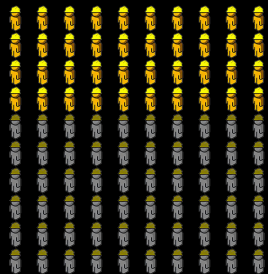
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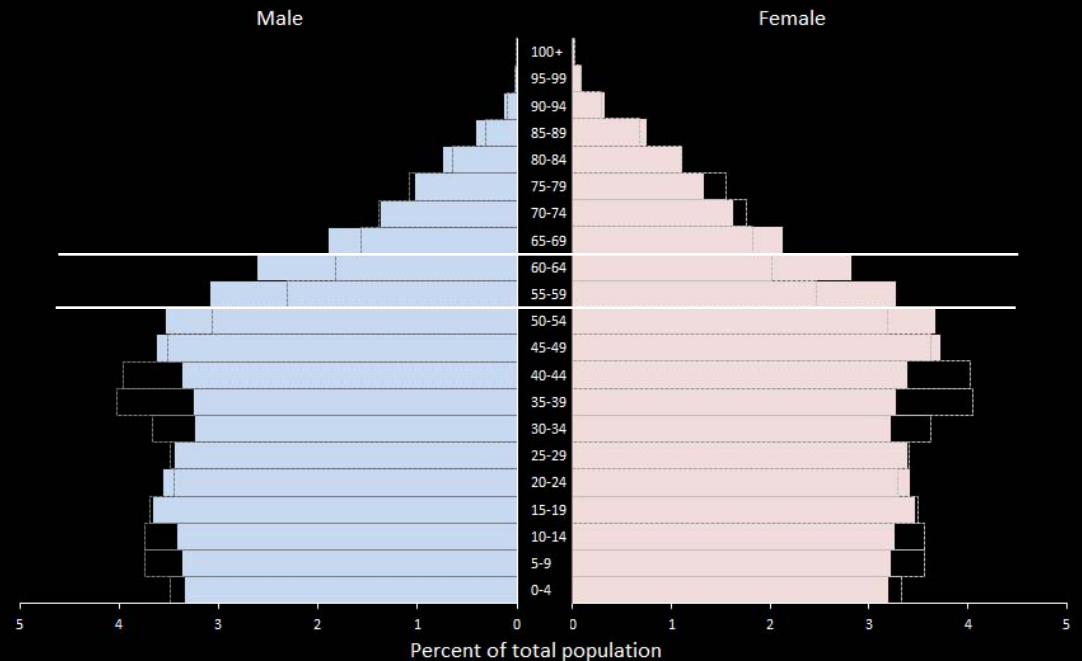


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2010 United States
 2000 United States

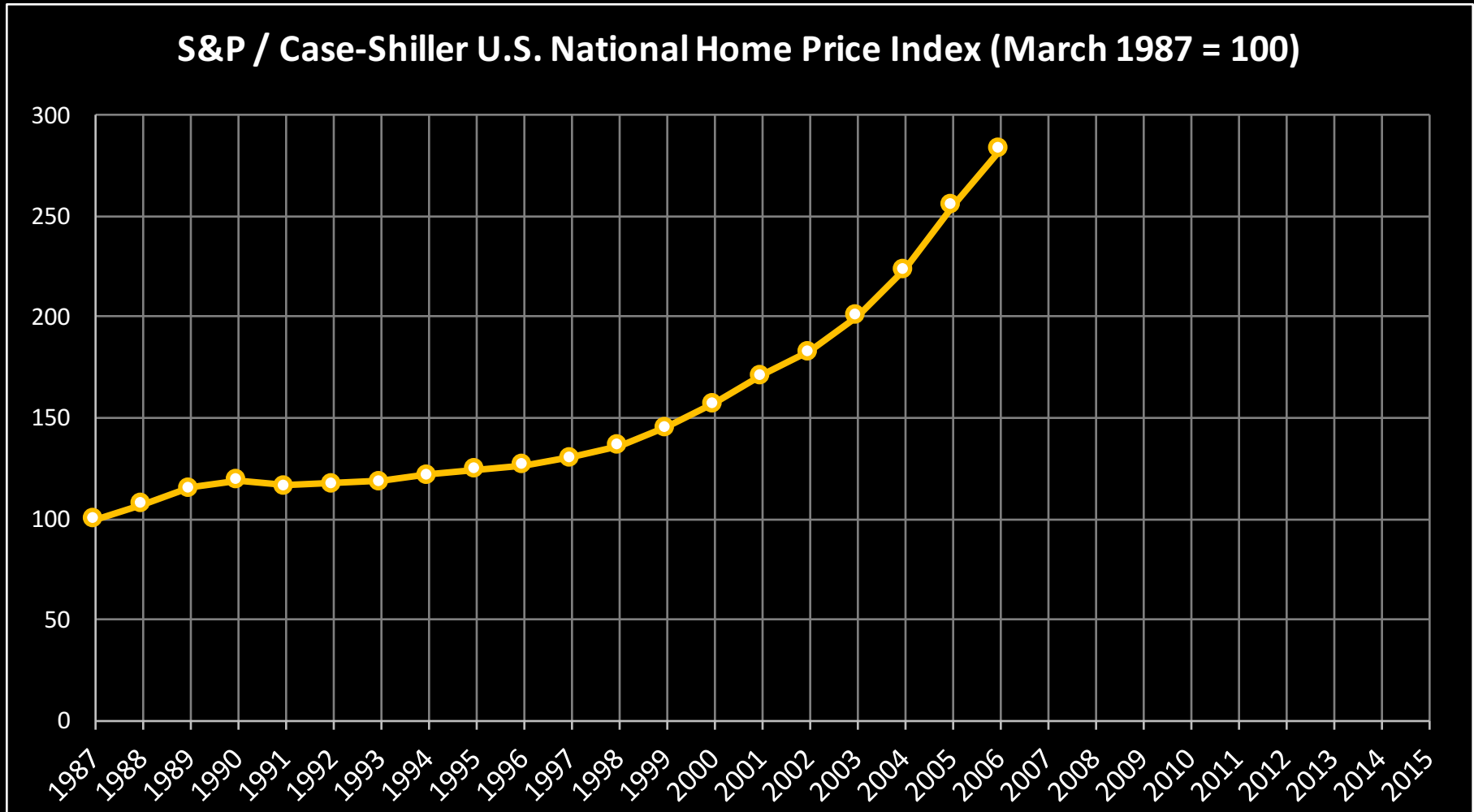


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Introduction: Baby Boomers and Housing Market

The Crash and Recovery of the U.S. Housing Market

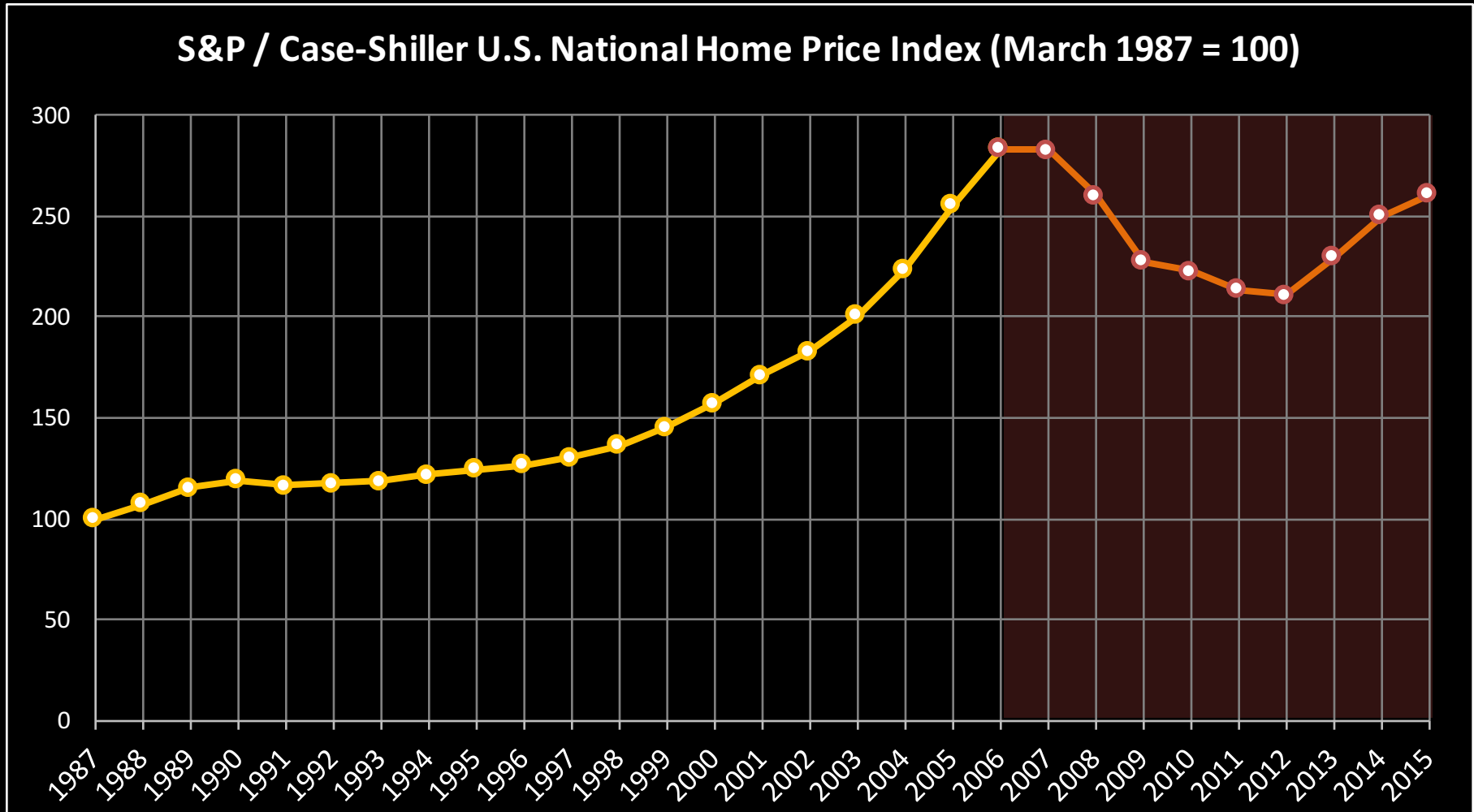


Source: S&P Dow Jones Indices. "S&P/Case-Shiller U.S. National Home Price Index."

<http://www.spindices.com/indices/real-estate/sp-case-shiller-us-national-home-price-index>

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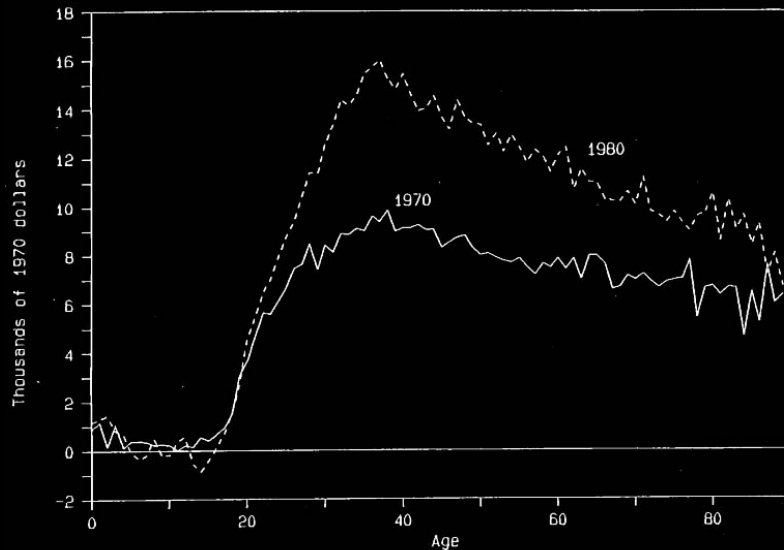
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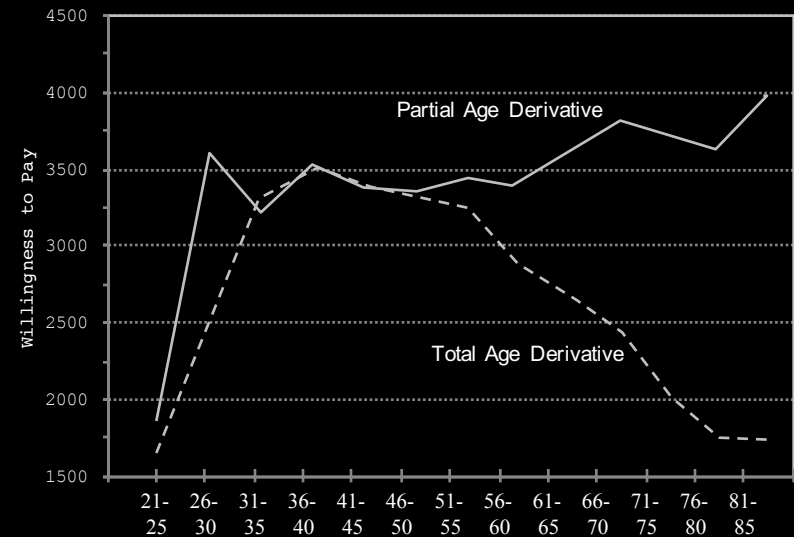
Literature Review:: Demographics and Housing Demand

Age and housing demand

Mankiw and Weil (1989)



Green and Hendershott (1996)



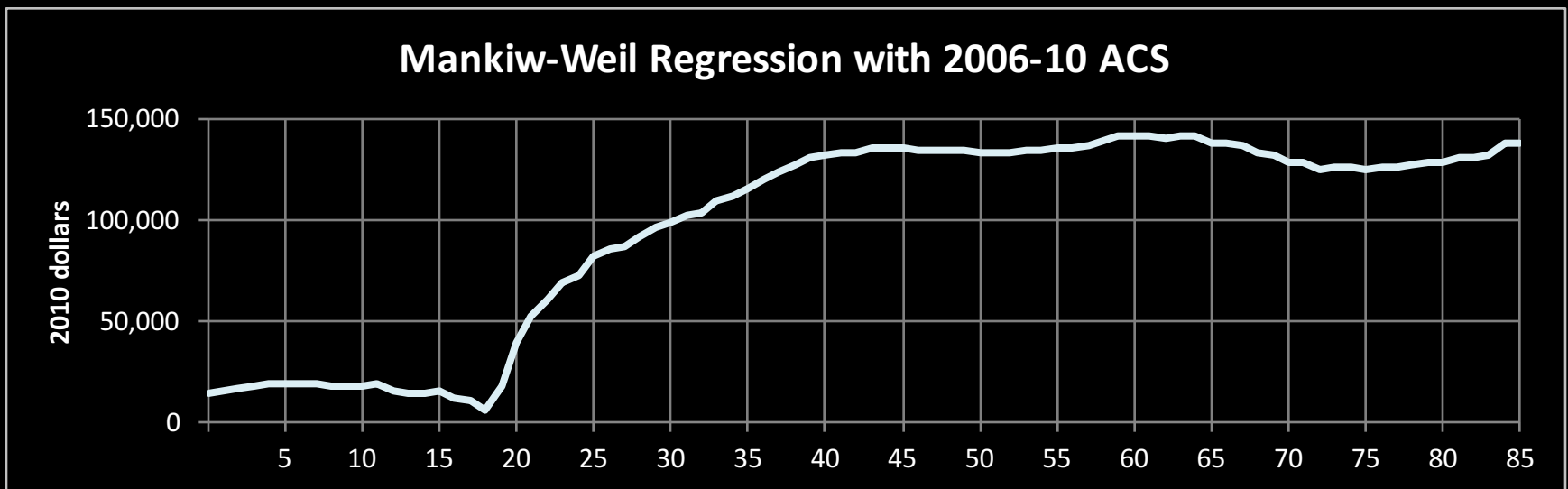
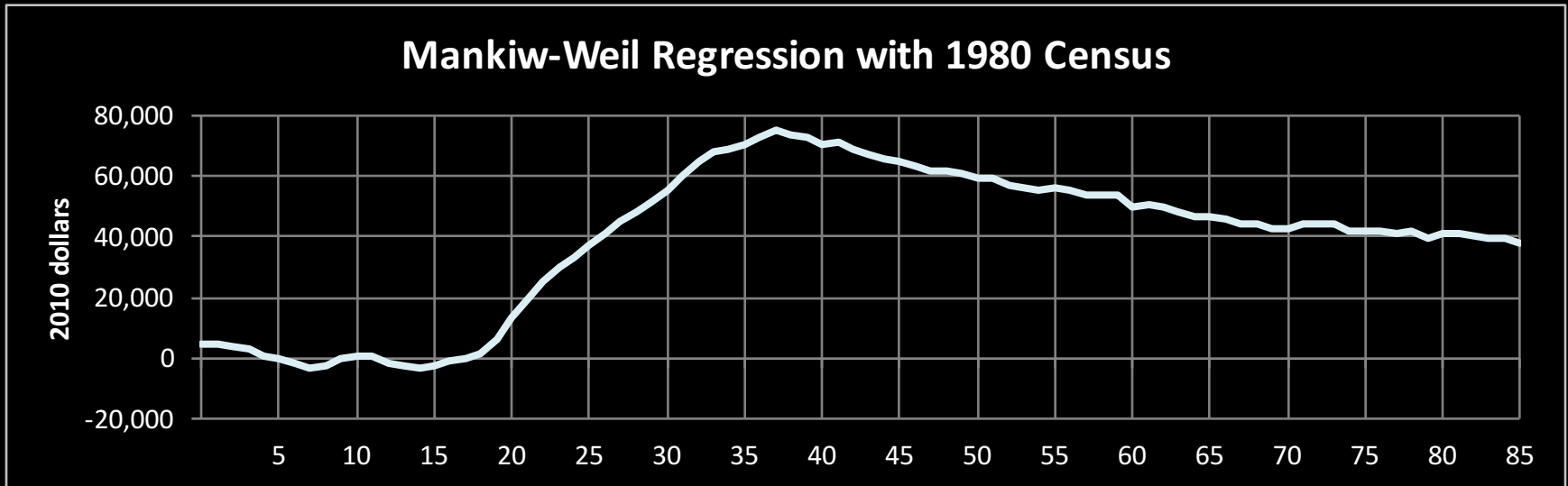
Housing demand projections

Demand will decline by 3 % per year
or 47 % between 1987 and 2007

Demand per household will grow 1 –
2% annually and aggregate demand
will increase by 15% after 2000

Literature Review:: Demographics and Housing Demand

Mind the gap: Mankiw-Weil regression (unconditional)



Literature Review:: Demographics and Housing Demand

Research question

- (1) How does household willingness to pay for housing attributes vary depending on the stage of household life cycle, while controlling for other factors?
- (2) Are there generational differences in housing demands between birth cohorts, after controlling for income?
- (3) How will demand for housing services be changed by ongoing demographic change in the near future?

Method and Data:: Hedonic Price Model

Hedonic Price Model (Rosen, 1974)

- The basic idea is that products are bundles of characteristics, and the prices of goods are determined by their utility-bearing attributes or characteristics
- The model provides theoretical basis for linking the consumer's characteristics to implicit marginal prices for the hedonic characteristics

Step 1. $q = f(\mathbf{Z}) = f(z_1, z_2, z_3, \dots, z_n)$

where q is the observed price of a product and \mathbf{Z} is a vector of n hedonic characteristics of the product

- Employing log-log model to approximate a certain demand function

$$\ln q = \alpha_0 + \sum_{i=1}^n \alpha_i \ln z_i + \varepsilon,$$

- The function is **homogeneous of degree one** ($\sum_{i=1}^n \alpha_i = 1$) while it imposes fewer restrictions than other functional forms

$$q_i = \frac{\partial q}{\partial z_i} = \frac{\alpha_i q}{z_i}$$

Method and Data:: Hedonic Price Model

Hedonic Price Model (Rosen, 1974)

Step 2. $q_i = g_i(Z, Y)$

the implicit marginal prices of the housing characteristics are determined by hedonic characteristics and consumer's taste variables (age, income, etc.)

$$\widehat{q}_{ij} = \beta_i Z_j + \gamma_i A_j + \zeta_i C_j + \psi_i X_j + \sum \tau_i year_t + \mu_{ij},$$

\widehat{q}_{ij} : estimated implicit price for a housing characteristic i of household j

Z_j : a vector of n hedonic characteristics

A_j : a set of dummy variables for age of householder

C_j : a set of dummy variables for birth cohort of householder

X_j : a vector of other demographic and economic characteristics

(race/ethnicity, sex, marital status, non-housing income, etc.)

Method and Data:: Hedonic Price Model

Hedonic Price Model (Rosen, 1974)

Step 3. estimating the average willingness to pay of households headed by v-year old and is of a generation w for a hedonic characteristic i of constant-quality house

$$\widehat{q_{ivw}} = \widehat{\beta}_i Z_c + \widehat{\gamma}_{iv} + \widehat{\zeta}_{iw} + \widehat{\psi}_i \overline{X_{vw}} + \sum \widehat{\tau}_i \overline{year}_t$$

and reconstructing the willingness to pay of households headed by v-year old in generation w for a constant-quality house using a Euler's Theorem

$$q_{vw} = \widehat{q}_{vw} \cdot Z_c = \sum_{i=1}^n \widehat{q}_{ivw} Z_{ci}$$

and forecast the future real house prices, both per household and in aggregate, using the recovered willingness to pay for a constant-quality house and household projections made by the Joint Center for Housing Studies (McCue, 2014)

Constant-quality house

- The constant-quality house here is defined as the house with average hedonic characteristics \bar{z}_i in the sample

Method and Data:: Data Source and Variables

Data Source

- Census 1990 and 2000 5% Public Use Microdata Sample (PUMS); 2006, 2010, and 2014 American Community Survey 1-Year PUMS
- People living in group quarters and 'boat, RV, and van' are excluded

q: the flow of housing services consumed through each census year

- For renters: annual gross rent (inflation adjusted)
- For owners: user cost of housing capital estimated by the NBER's TAXSIM model

Housing Characteristics

- House age; number of bedrooms; number of other rooms; structure type
- PUMA level: distance to CBD; population density; % BA+; % non-Hispanic White; state fixed effects

Household Characteristics

- Age and birth cohort dummies; marital status; race/ethnicity, nativity and length of residence in the U.S.; educational attainment; non-housing household income (household income less housing expenditure)

Results:: First Stage Hedonic Regression, 1990 to 2014

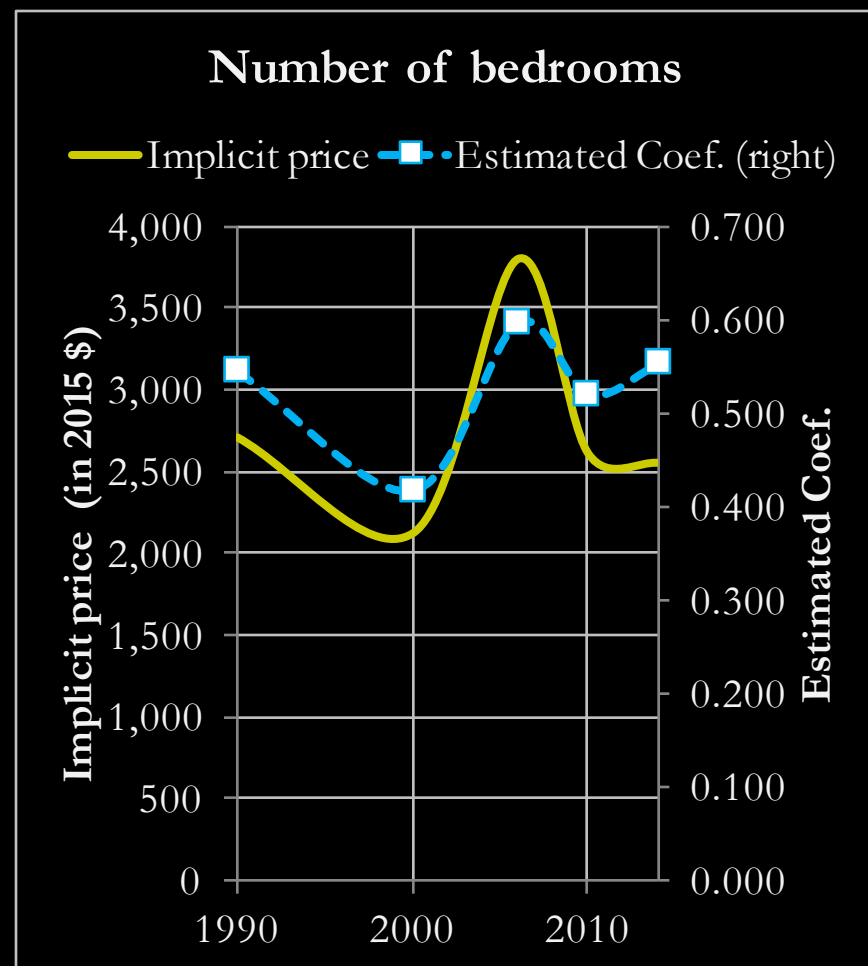
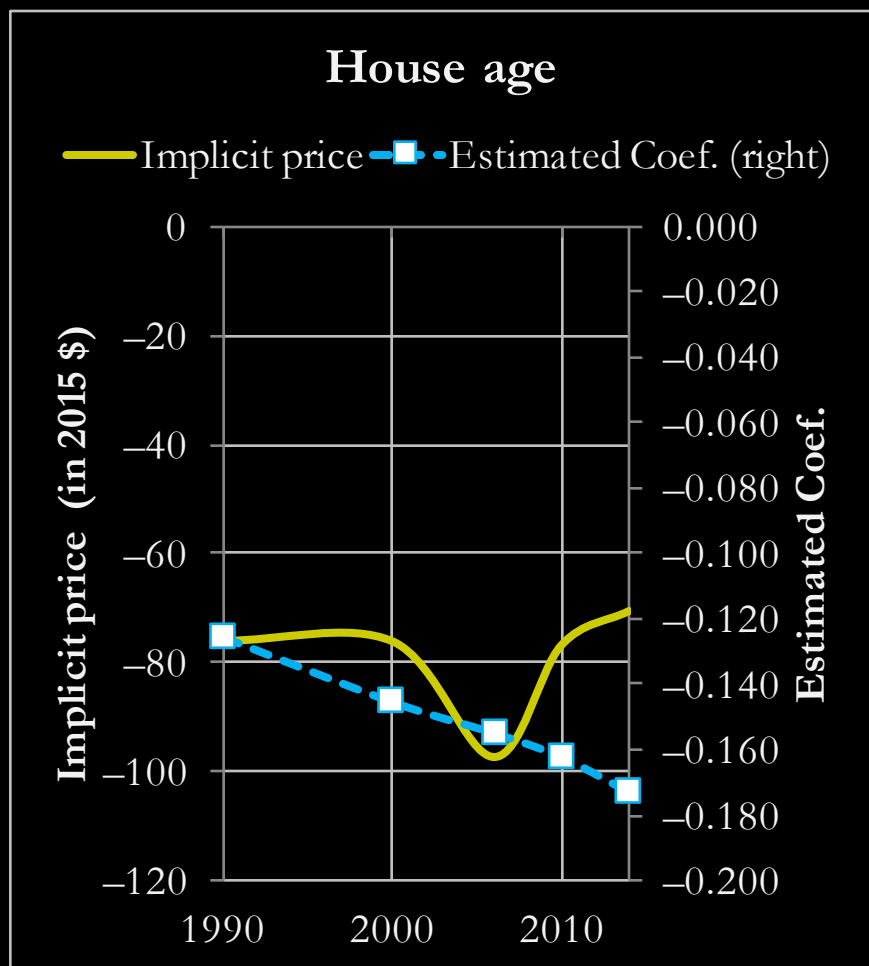
Table 1. The first stage hedonic regression results, 1990 to 2014

$$\ln q = \alpha_0 + \sum_{i=1}^n \alpha_i \ln z_i + \varepsilon,$$

	1990	2000	2006	2010	2014
Housing Characteristics					
House age	-0.126 (0.000)	-0.146 (0.000)	-0.155 (0.001)	-0.162 (0.001)	-0.173 (0.001)
Number of bedrooms	0.544 (0.001)	0.416 (0.001)	0.597 (0.003)	0.520 (0.003)	0.552 (0.004)
Number of other rooms	0.272 (0.001)	0.246 (0.001)	0.273 (0.002)	0.234 (0.002)	0.203 (0.002)
Tenure	0.347 (0.001)	0.266 (0.001)	0.364 (0.002)	0.032 (0.002)	-0.181 (0.002)
Structure type (ref. detached single-family homes)					
Attached Single Family	-0.122 (0.001)	-0.154 (0.001)	-0.100 (0.003)	-0.119 (0.003)	-0.153 (0.004)
Condominium	-0.107 (0.001)	-0.152 (0.001)	-0.146 (0.003)	-0.178 (0.003)	-0.186 (0.003)
Mobile Home	-1.000 (0.002)	-1.000 (0.002)	-1.098 (0.005)	-1.100 (0.006)	-1.114 (0.006)
PUMA Characteristics					
Distance to CBD (in miles)	0.013 (0.000)	0.009 (0.000)	0.016 (0.001)	0.023 (0.001)	0.009 (0.001)
Population density (per square mile)	0.054 (0.000)	0.044 (0.000)	0.057 (0.001)	0.049 (0.001)	0.036 (0.001)
Share of people with BA+ (%)	0.230 (0.001)	0.285 (0.001)	0.351 (0.002)	0.417 (0.002)	0.426 (0.003)
Share of people who are NH-White (%)	-0.063 (0.001)	-0.087 (0.001)	-0.042 (0.002)	-0.038 (0.002)	-0.051 (0.002)
Unemployment rate (%)	-0.312 (0.001)	-0.275 (0.001)	-0.160 (0.002)	-0.103 (0.003)	-0.145 (0.003)
State FEs	Yes	Yes	Yes	Yes	Yes

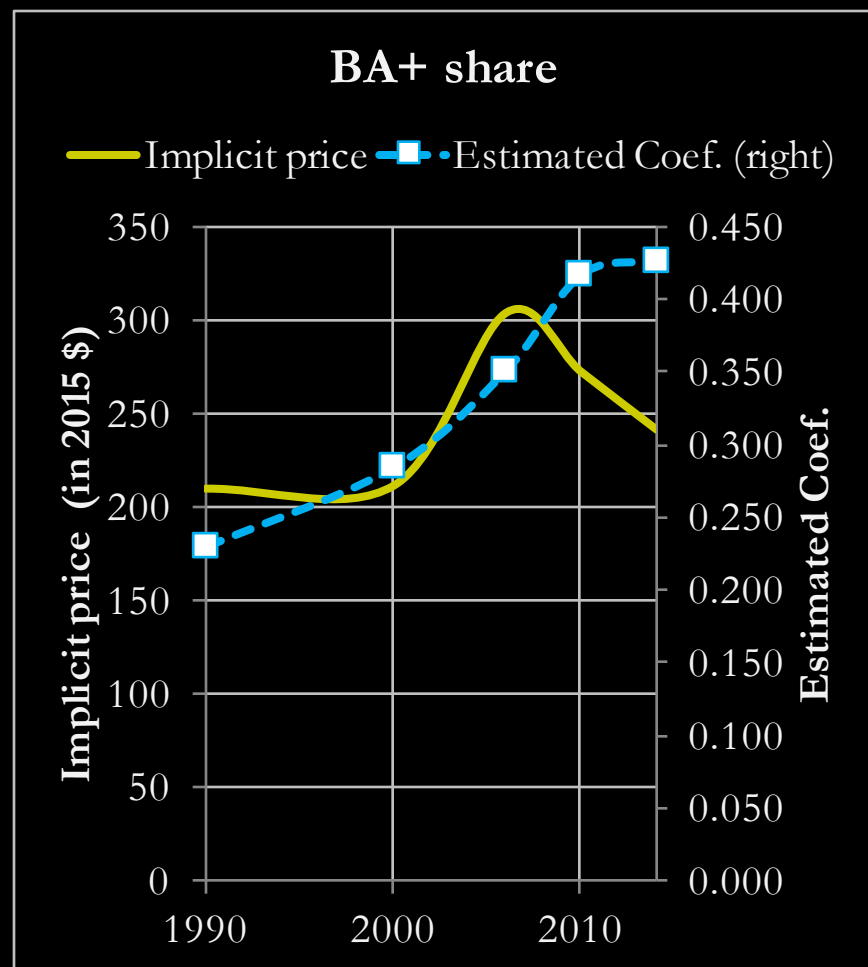
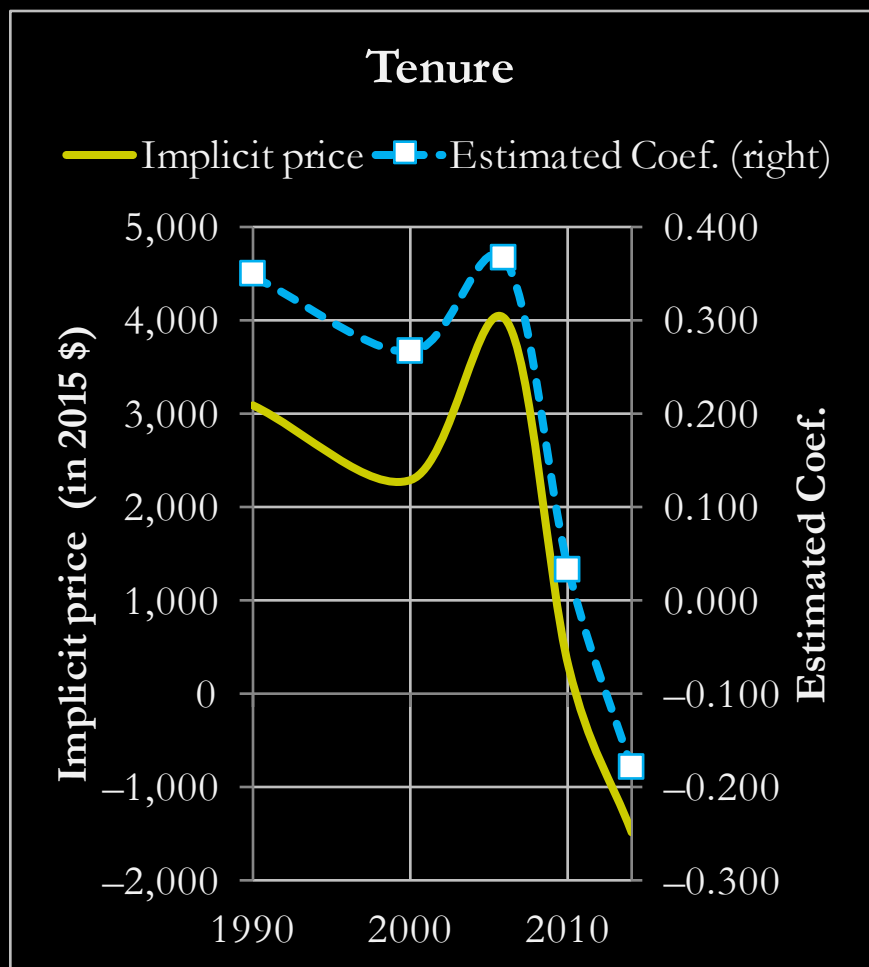
Results:: First Stage Hedonic Regression, 1990 to 2014

Figure 1. Changes in estimated regression coefficients and implicit prices for housing unit with average housing characteristics, 1990 to 2014 (selected)



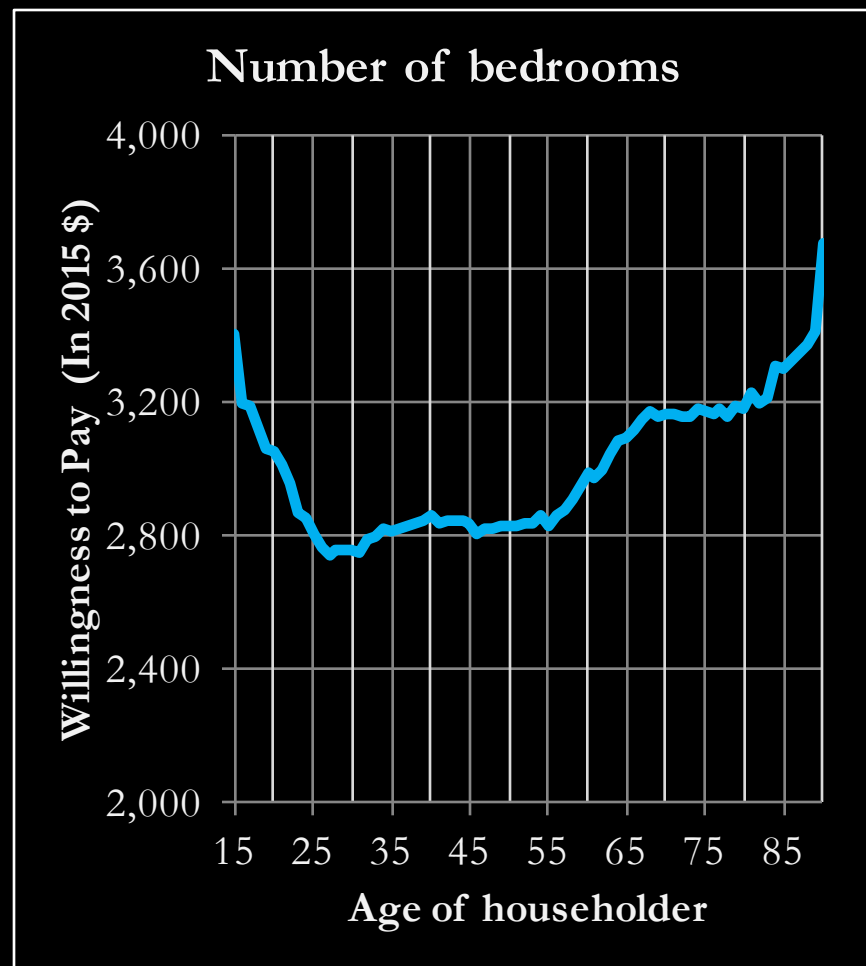
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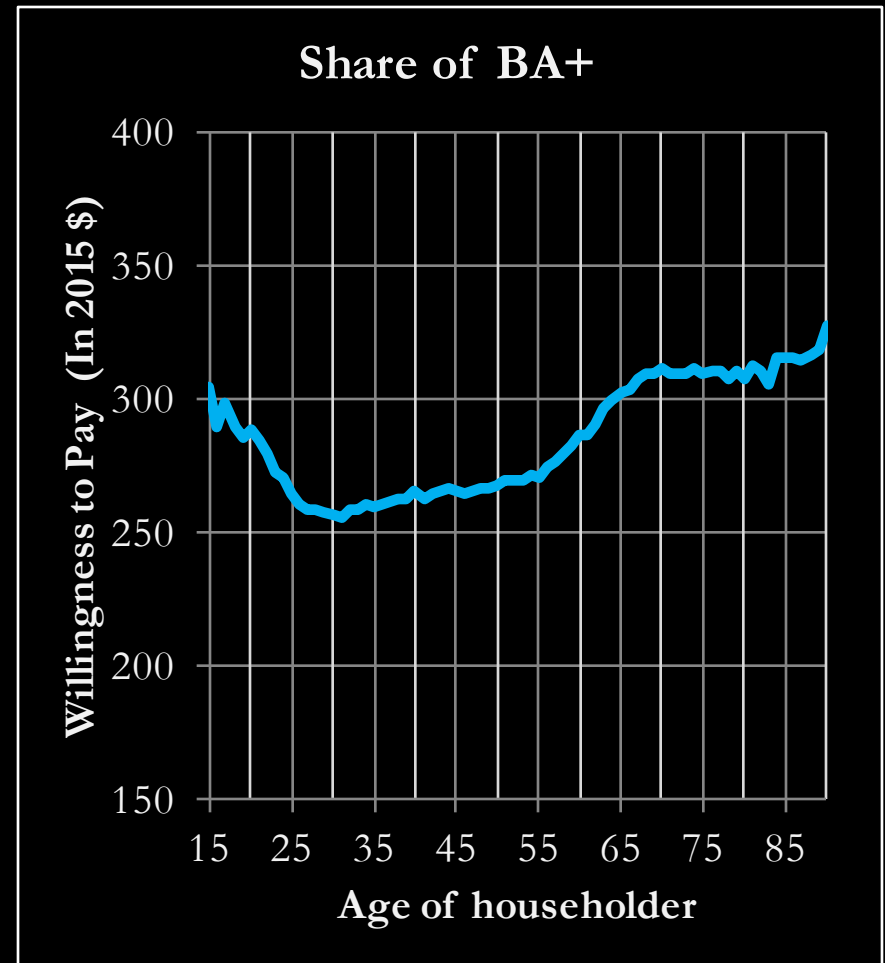
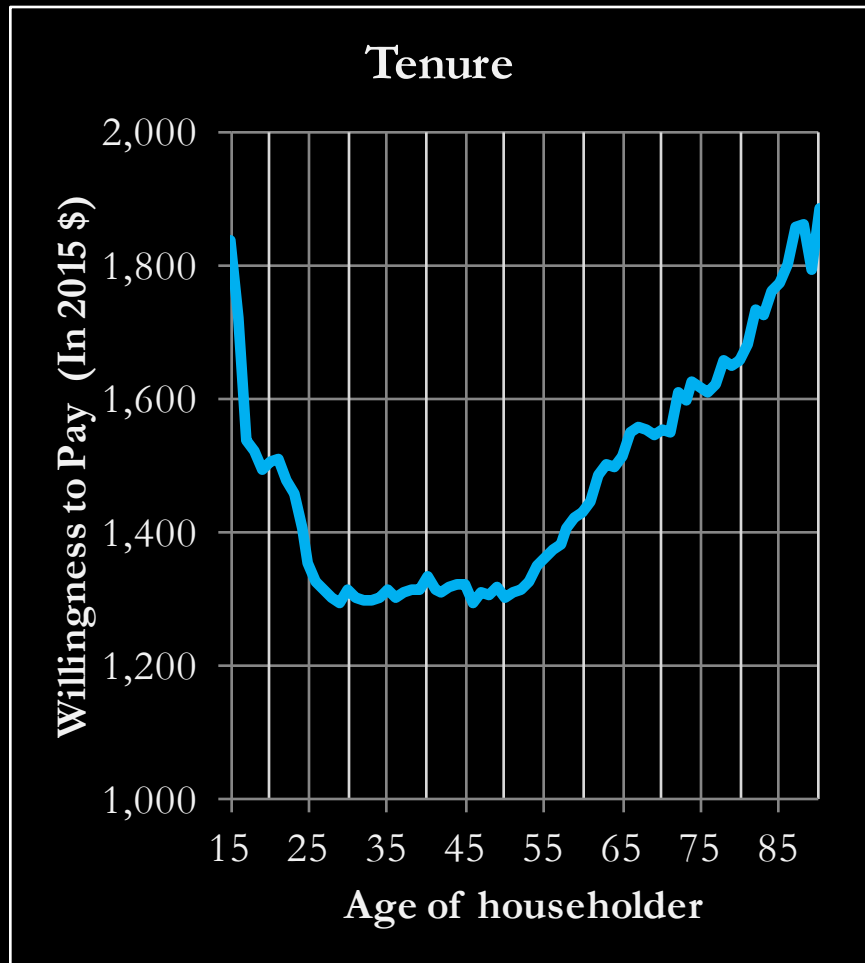
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Figure 2. Willingness to pay for housing characteristics by age of householder



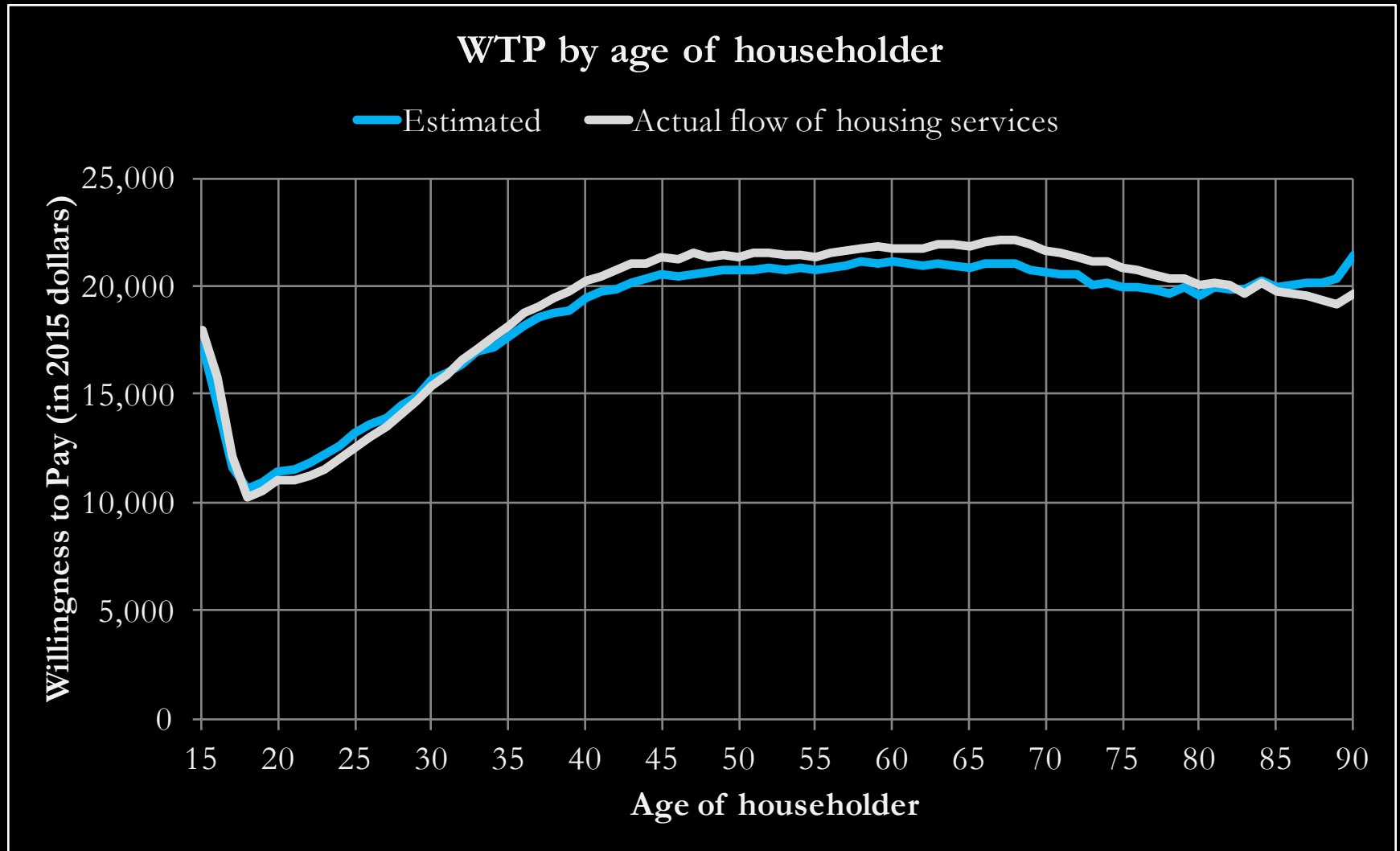
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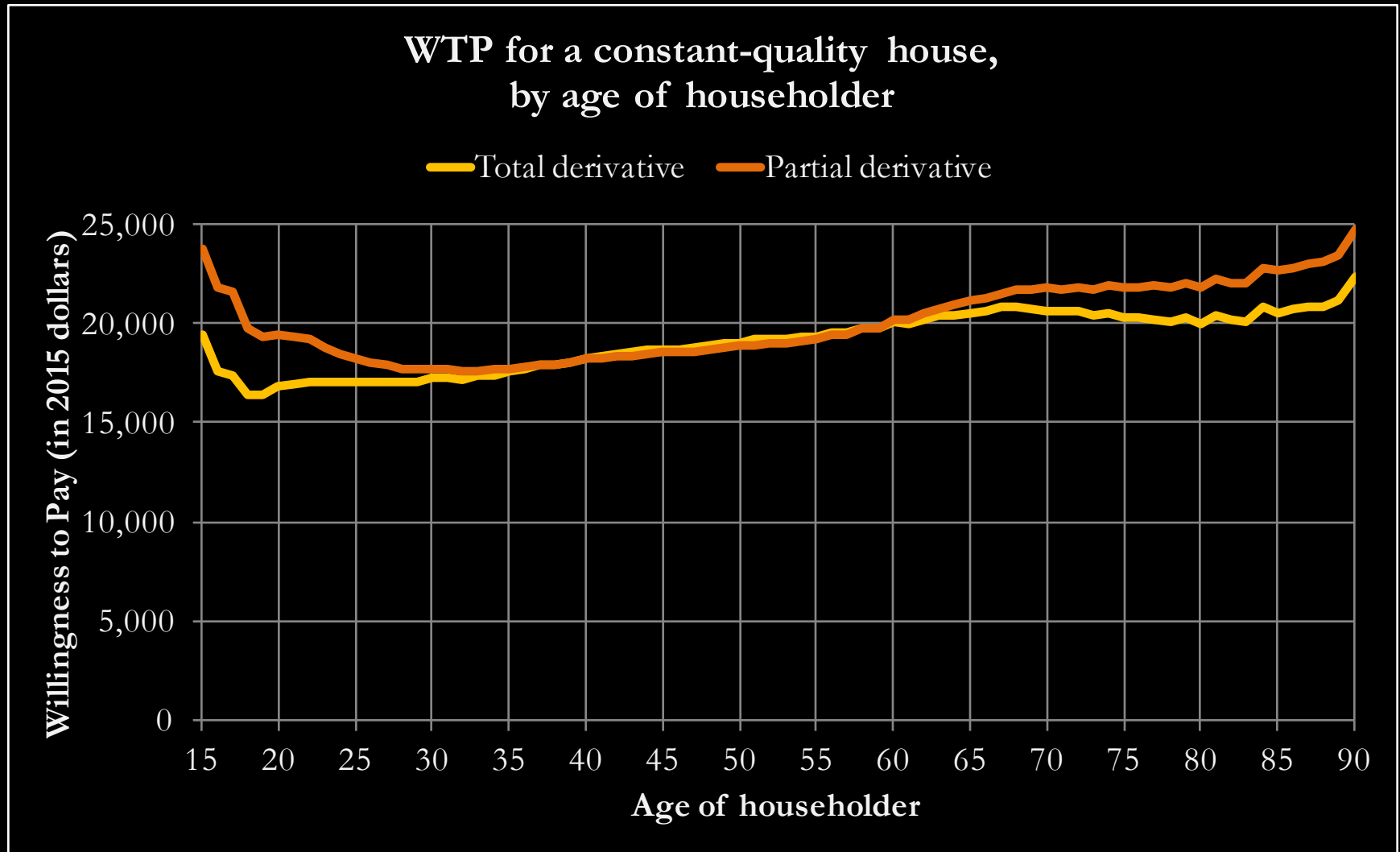
Results:: Second Stage Hedonic Regression, 1990 to 2014

Figure 3. Willingness to pay for a house with average quantities by age of householder, actual and estimated values



Results:: Second Stage Hedonic Regression, 1990 to 2014

Figure 4. Willingness to pay for a constant-quality house by age of householder, total and partial derivatives with regards to age



Results:: Second Stage Hedonic Regression, 2000 to 2011

Figure 5. Willingness to pay for a constant-quality house by demographic and socio-economic groups

	Avg. flow of housing services		Willingness to Pay	
	In 2015 dollars	Relative	In 2015 dollars	Relative
Birth cohort				
Good Warriors (pre 1929)	20,346	100.0	19,270	100.0
Lucky Few (1929-1945)	22,184	109.0	19,254	99.9
Baby Boomers (1946-1964)	20,627	101.4	18,786	97.5
Generation X (1965-1982)	17,205	84.6	18,909	98.1
Millennials (1983-2000)	12,621	62.0	18,125	94.1
Race/ethnicity				
NH-White	20,694	100.0	19,622	100.0
African American	12,949	62.6	15,487	78.9
Asian & P.I.	28,409	137.3	18,421	93.9
Hispanic	16,304	78.8	17,734	90.4
Other	16,512	79.8	19,985	101.9
Nativity/length of residence				
Native-born	19,166	100.0	18,743	100.0
New Immigrant	16,887	88.1	20,492	109.3
Long-term immigrant	24,101	125.7	20,045	106.9
Marital Status				
Married couple	23,276	100.0	19,489	100.0
Widowed	17,877	76.8	18,152	93.1
Divorced	15,469	66.5	17,696	90.8
Separated	13,696	58.8	18,449	94.7
Never married	14,281	61.4	18,829	96.6
Educational attainment				
High school dropout	13,135	100.0	16,652	100.0
High school graduate	15,545	118.3	18,174	109.1
Some college and Associate's degree	18,239	138.9	18,980	114.0
Bachelor's degree	25,539	194.4	20,391	122.5
Master's degree or higher	31,859	242.5	21,516	129.2

Results:: Housing demand projections, 2020 to 2035

Figure 6. Housing demand projections for a constant-quality house

	1990	2000	2006	2010	Actual 2014	2020	2025	Projected 2030	2035
Aggregated housing demand (in 2015 million dollars)									
High	1,768	1,939	2,746	2,245	2,148	2,478	2,600	2,717	2,823
Middle	1,768	1,939	2,746	2,245	2,148	2,472	2,585	2,690	2,781
Low	1,768	1,939	2,746	2,245	2,148	2,466	2,571	2,663	2,738
Annualized growth rate (%)									
High		0.93	5.97	-4.92	-1.09	2.41	0.96	0.89	0.77
Middle		0.93	5.97	-4.92	-1.09	2.37	0.90	0.80	0.67
Low		0.93	5.97	-4.92	-1.09	2.33	0.83	0.71	0.56
Per household housing demand (in 2015 dollars)									
High	18,888	18,507	23,981	18,938	17,455	18,768	18,766	18,777	18,761
Middle	18,888	18,507	23,981	18,938	17,455	18,773	18,779	18,798	18,791
Low	18,888	18,507	23,981	18,938	17,455	18,778	18,791	18,820	18,821
Annualized growth rate (%)									
High		-0.20	4.41	-5.73	-2.02	1.22	0.00	0.01	-0.02
Middle		-0.20	4.41	-5.73	-2.02	1.22	0.01	0.02	-0.01
Low		-0.20	4.41	-5.73	-2.02	1.23	0.01	0.03	0.00

Note: The housing demand projections are made by applying estimated willingness to pay for a constant housing into the updated Joint Center for Housing Studies household projections (McCue, 2014) by age and race/ethnicity of householder. Its high, middle, and low household projections corresponds the 2012 Census Bureau high-, middle-, and low-series population projections.

Conclusion:: Summary and Policy Implications

Changes in the implicit prices of housing attributes during boom and bust

- The implicit prices of the housing characteristics changed dramatically after the crash, reflecting their different types of goods and external economic situation

Age-specific Housing Demand

- Holding other variables constant, the demand for housing does not decrease as age increases, confirming Green and Hendershott (1996)

Projected Future Housing Demand and Policy Implications

- Demographic changes might not reduce the housing demand in the near future; the impact of aging and retirement of boomers on housing market will be limited
- There might be other factors have more critical impacts on housing market: employment status, education, etc.